

REVIEWS

Balls's Cotton Plant in Egypt*

The publication of Mr. Balls's book is of general interest in the world of plant breeding, since it gives the results of a very extensive series of experiments and represents one of the most general and efficient attempts at placing the breeding of an important crop plant on a Mendelian basis. Other investigators have done more extensive and intensive work on particular phases of Mendelism and on particular characters of other plants, but Balls has carried through a much more general campaign in the application of the Mendelian methods. The credit of the achievement should be all the greater because the work has been done under conditions that most investigators would consider very difficult. While the temperatures of the Egyptian summer are not so extreme as those that are encountered in our southwestern states, our pioneer conditions afford in other respects a more favorable atmosphere for experimental work than the vicinity of a large oriental city like Cairo.

Egypt might be described as a two-crop country, but the two industries are entirely separate. The tourist crop comes in the winter while cotton grows in the summer, when nobody stays in Egypt who can get away. The investigations of ancient remains, which have made Egypt so famous, are mostly conducted in the winter. This explains why the tourist literature of Egypt exceeds a thousand fold the cotton literature. But Mr. Balls is a tireless investigator, and at last we have one book about the Egyptian cotton that is not confined to statistics of production or to agricultural generalities.

That we do not get all that we might expect is no reason for being ungrateful for many new facts and suggestions of improved methods of investigation. It is in this latter field of methods that the work of Balls seems likely to be most appreciated. Certainly those who wish to employ all the physiological and statistical expedients for the elaboration of biological data will

*The Cotton Plant in Egypt, Studies in Physiology and Genetics, by W. Lawrence Balls, pp. 1-202, figs. 1-71. Published by MacMillan Co., 1912, price \$2.50.

find in this volume an ample storehouse of examples and suggestions. In the absence of any adequate agricultural facilities, the author has carried through an immense amount of laboratory work and now makes a memorable contribution to his subject. The general factors, and especially the effects of light, heat and moisture in different stages of growth, receive detailed treatment and many significant relations are revealed.

To criticize the work because of a lack of agricultural conclusions would be entirely unfair, for the author shows everywhere a notable caution in claiming practical applications. If anything is to be criticized it is the methods that were followed in the breeding work, but even on this ground criticism would hardly be just, for the reason that these particular methods have had the highest approval in the scientific world during the period of Mr. Balls's work in Egypt.

Perhaps the most direct claim to definite results secured by the Mendelian methods of breeding is on page 119, which gives an account of the breeding of a short-styled variety, in order to lessen the danger of cross-pollination. Short-styled hybrids were secured by crossing the Egyptian cotton with American Uplands, and one of the hybrid strains is described as breeding true for five generations. But the undertaking was abandoned on account of the large number of "rogues" that continued to appear. The Mendelian inferences were preserved by ascribing the rogues to crossing, although the proportion of variants was higher than appeared in other experiments with natural crossing or even with artificial mixing of pollen. The conclusion was drawn that "the accessibility of the style [doubtless meaning stigma] is a minor factor in natural crossing, under the conditions of our breeding plot."

Nevertheless, this experiment seems to have led to a more careful study of the problem of natural crossing or "vicinism" as it is called, in which several interesting points were developed. That some of the results of crossing are greatly at variance with those that have come from similar experiments with Egyptian crosses in the United States, only makes them the more interesting as indications of unsuspected influences of external conditions

or varietal differences. Several of the disturbing factors of such experiments are recognized in Balls's analysis. One excellent point is that account must be taken of the number of seeds planted in such experiments, rather than of the plants that survive, for under adverse conditions only the hybrid plants may survive, so that incautious experimenters might report very high percentages of crosses. Indeed, Balls alludes to cases where only the hybrids survived.

One of the chief defects of modern Mendelian and statistical methods is seen when the book is considered as a record of botanical or biological observations. These methods often seem to keep the student from becoming acquainted with his plants or animals, doubtless because the numerical considerations absorb most of his attention, and leave comparatively little for observation of other features. Thus we read of "the apparent identity of all the modern varieties of Egyptian cotton in external appearance," and "the absence of differentiating characters, excepting for the lint itself," and other similar statements, which show that the experiments did not result in the kind of familiarity with the plants that is necessary for the most effective breeding work. The extensive contamination of the Egyptian crop with the so-called Hindi cotton also seems to have attracted very little notice. The striking morphological features of the dimorphic branches are passed with a casual reference. Of the same nature is the following statement on page 147:

"The F_1 of Aegypto-Upland crosses is always a superfine Egyptian. Thus, the mating of a 'bread-and-cheese' Egyptian with a short-staple Upland gives a first cross bearing such lint as is required by the fine spinner."

It is true that such hybrids usually yield lint superior in length and strength to that of the Egyptian parent, but it is a mistake to suppose that the hybrid lint is of the same quality as the Egyptian from the standpoint of the manufacturer. The "fine spinner" always distinguishes samples of such lint from the genuine Egyptian, and is more likely to take them for Sea Island or for extra-fine qualities of long-staple Upland than to recognize their Egyptian parentage.

With regard to problems of genetics the author's usual attitude is that of the professed and altogether convinced Mendelian. The Mendelian principles are supposed to control the heredity of all kinds of characters, though "autogenous fluctuation" is sometimes invoked in extreme cases. Like some of our American Mendelists, our author asserts his convictions the more emphatically when the facts seem to be carrying him away from the typical Mendelian points of view, as the following paragraphs will show:

"The author can only reiterate his conviction that all these hybrids are subject to Mendel's Law of segregation; often obscurely—on account of defective methods—but none the less certainly. The evidence available can all be interpreted in Mendelian terms, and it is very significant that most of it should appear at first glance to be completely dissociated from the classical ratios. Mendelian students of heredity have confined themselves to the more definable characters, such as color, partly because statistical characters take up an excessive amount of time in mere determination, and partly because the use of statistical methods is prone to provoke irrelevant criticism from mathematicians with whom the mere biologist cannot fairly compete. At the same time it is clear that the frontier of Mendel's territory is not demarcated by any special character and—with all their experimental disadvantages—the only characters which admit of complete treatment are those which can be measured with definable precision. There are many features of these complex results which bear a tantalizing resemblance to problems of human heredity" (p. 132).

Nor is our author lacking in scientific candor when the time comes for general statements regarding the practical application of Mendelism to the lint characters, and to the other features of the plant that do not lend themselves to direct statistical treatment.

"From what has been said above it will be clear that the 'style' of a lint sample is the resultant of an unknown number of unknown factors, both zygotic and gametic. When a set of F_2 samples is placed before an expert, this becomes obvious; the

expert finds one lint which resembles Afifi, except that it has the color of Yannovitch; he next meets another which has the color of Afifi, but which he would unhesitatingly affirm to be American Upland if the room were darkened. The task of analyzing an F_2 in this way is almost hopeless, however valuable the results may be for other purposes" (p. 147).

"We have now examined the nature of the problems which the non-measurable characters present. The general trend of the evidence is to show that inheritance becomes more complex as the crossed parents are less and less closely related. The amount of labor which the author has been able to apply to these problems, under the limitations imposed by natural crossing and accidental circumstances, has not been enough to produce one clean and indisputable proof for any character. Nevertheless, he believes that the preceding discussion will be found by later workers to represent the general position of a complex subject" (p. 149).

The expectation was that Mendelian breeding of new varieties would save the Egyptian industry from the danger of deterioration that seemed to be threatened. But the methods that were applied did not lead to an appreciation of the possibility of developing uniform Hindi-free strains of Egyptian cotton by the simple and direct means of individual selection and roguing of progenies and seed fields, as has been done in the United States. The new varieties that have gained prominence recently in Egypt, such as Assil and Sakellaridis, seem to have been developed without any relation to Mendelian investigations.

The practical utility of a scientific investigation often proves to be entirely different from what was expected. Though no direct applications of Mendelism seem to have resulted from the experiments, another important service was rendered. On the basis of his physiological studies Mr. Balls was able to give a biological confirmation of the idea that the increased supply of water made available through recent improvements of irrigation facilities in Egypt were responsible for a serious deterioration of the cotton crop. Extensive drainage works are now in progress as a means of controlling the subterranean water table in the cotton-growing districts of Lower Egypt.

Even on strictly scientific grounds, and apart from all questions of practical application, botanical readers are likely to agree that the investigations have given much more interesting results in other lines of research than in those that relate to genetics. Indeed, our author has recognized this on his own account, in the conclusion of his last chapter on heredity.

"All the characteristics mentioned in the chapter on Fluctuation have been made the subject of statistical records in the ordinary course of routine observations. Thus we possess the curves for growth, flowering, bolling, and shedding for almost every individual studied. Data for weight of lint per seed, and for ginning out-turn are also to hand, but the majority of these records are of more value as supplementary sources of information in physiology than from the standpoint of Genetics. At the same time, they are frequently of interest as showing the commercial resultant of those conflicting gametic forces whose lines we have endeavored to trace" (pp. 173-175).

O. F. COOK

PROCEEDINGS OF THE CLUB

MARCH 26, 1913

The meeting of March 26, 1913, was held in the laboratory of the New York Botanical Garden at 3:30 P.M. Vice-President Barnhart presided. Twenty-two persons were present.

The minutes of the meeting of March 11 were approved. Dr. John H. Barnhart, chairman of the budget committee, submitted the following report which was adopted:

ESTIMATED INCOME	
Dues from members.....	\$1,000.00
Additional dues from sustaining members.....	140.00
Bulletin.....	885.00
Torrey.....	125.00
Memoirs.....	400.00
Index cards.....	200.00
Advertisements.....	50.00
Interest on invested funds.....	50.00
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	\$2,850.00